



Night Vision Goggle Driving Operations



AGENDA



1. Basic Night Operations
2. Operations using the AN/PVS-5
3. Operations using the AN/PVS-7A
4. Operations using the AN/PVS-7B
5. Driving with night vision goggles



NIGHT VISION GOGGLE DRIVING OPERATIONS

Night Operations



Depth Perception



Height and

Distance



Visual Acuity



**Terrain Features &
Obstacles**

Night Vision Techniques

**Effective Night
Operations**

a. **Vision.** This is the most important sense you use while driving. It is the sense that makes you aware of the position of your vehicle in relation to the road. You need good depth perception for determining height and distance, good visual acuity for identifying terrain features and obstacles, and good night vision techniques for efficiency in night operations.

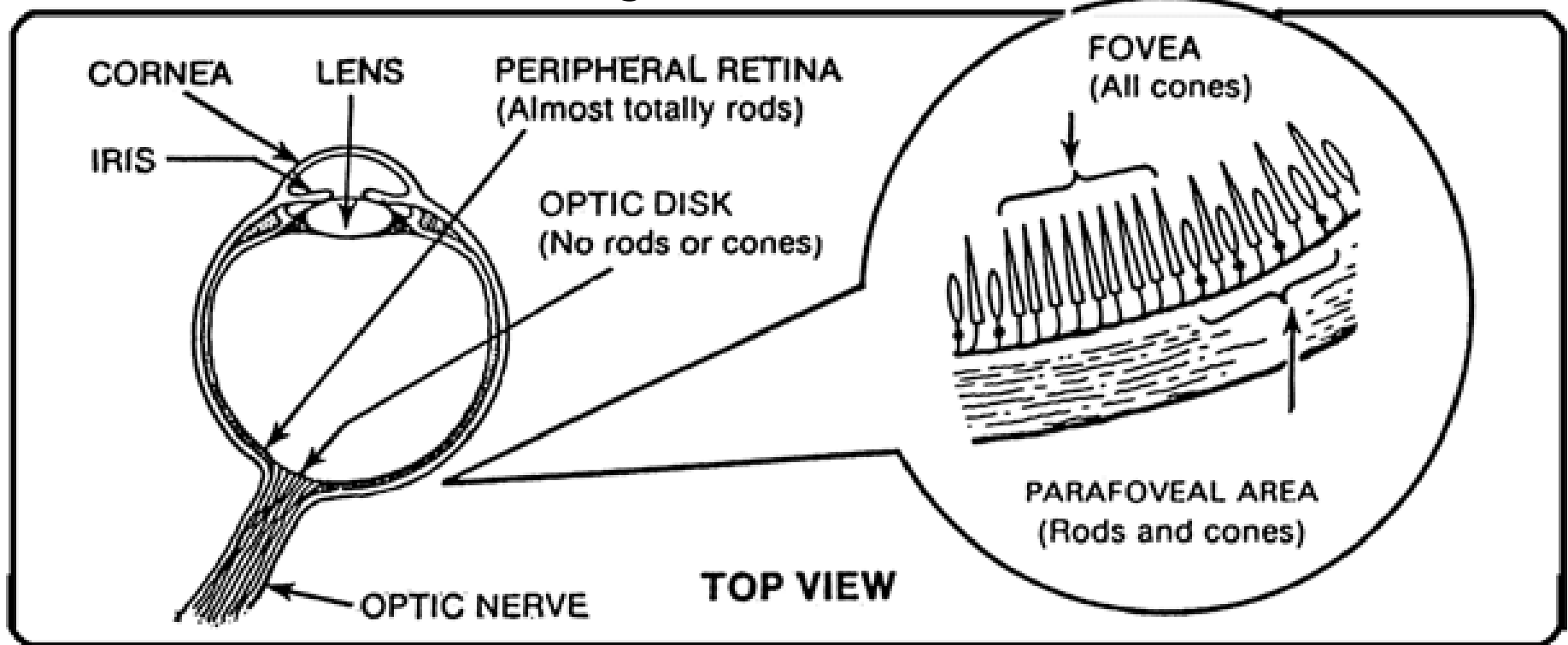


NIGHT VISION GOGGLE DRIVING OPERATIONS

Anatomy of the Eye



Rods work in dim light while cones see color



Rods have Rhodopsin (or visual purple) a photochemical substance that collects electrical signals and sends them to the retina. It must be replaced each night because it is used up during the day, but this requires Vitamin A and rest.



NIGHT VISION GOGGLE DRIVING OPERATIONS

Types of Vision



PHOTOPIC



DAYLIGHT HOURS

MESOPIC



DAWN, DUSK, MID-LIGHT

SCOTOPIC



DAYLIGHT HOURS



NIGHT VISION GOGGLE DRIVING



OPERATIONS TYPES OF VISION

Three types of vision.

(1) Photopic vision is used during daylight hours or when a high level of artificial light exists.

(2) Mesopic vision is used at dawn, dusk, and during periods of mid-light levels. A reduction in color vision and visual acuity occurs as the light level decreases.

(3) Scotopic vision is used when low-level light conditions exist, such as at night.

Visual acuity decreases to 20/200 or less and total loss of color vision occurs.



NIGHT VISION GOGGLE DRIVING OPERATIONS TYPES OF VISION



Visual problems affecting night vision.

(1) Presbyopia is common in individuals over 40 years of age. Light transmission from the lens to the retina decreases. Instruments, maps, and so forth, are more difficult to read, especially in red light. This can be corrected with certain types of bifocal lenses.

(2) Night myopia occurs in a person who is nearsighted (myopic). He will experience blurred vision at night. Special lenses can be prescribed to correct this.

(3) Astigmatism is an out-of-focus condition in the eye. For example, if you focus on power poles, the wires will be out of focus in most



NIGHT VISION GOGGLE DRIVING OPERATIONS TYPES OF VISION



Dark Adaptation.

This is the process by which your eyes increase their sensitivity to low light levels. Maximum dark adaptation is reached in about 30 to 45 minutes. Exposure to a flare or lightning may require 5 to 45 minutes for night vision recovery.



NIGHT VISION GOGGLE DRIVING



OPERATIONS TYPES OF VISION

Night Tactical Operations Precautions

(1) If a flash or high-intensity light is expected from a specific direction, turn your head away from the light source. If direction is not known, close one eye. Once the light source is no longer a factor, the eye that was closed will provide enough night vision to continue driving. The reason for this is because dark adaptation occurs independently in each eye.

(2) Select routes to avoid built-up areas where there is a heavy concentration of light.

(3) Maneuver your vehicle away from the flare or high-intensity light source to the edge of the lighted area



NIGHT VISION GOGGLE DRIVING OPERATIONS *Self-Imposed Stresses*



Decreases Effective Night Vision

- **Smoking**
- **Alcohol**
- **Fatigue**
- **Nutrition**
- **Physical Condition**
- **Lack of Sleep**



NIGHT VISION GOGGLE DRIVING OPERATIONS

Self-Imposed Stresses



- (1)Smoking.*** The smoker effectively reduces his night vision ability by 20 percent.
- (2)Alcohol.*** This impairs both coordination and judgment.
- (3)Fatigue.*** When you are tired, you are not mentally alert; fatigue will slow down your response to night situations that require immediate reaction.
- (4)Nutrition.*** Hunger pains lead to distraction and a shortened attention span. Failure to eat foods that provide sufficient vitamin A (eggs, cheese,

NIGHT VISION GOGGLES DRIVING OPERATIONS

Self-Imposed Stresses



(5) *Physical conditioning.* You should exercise daily. Good physical conditioning will help you conduct night driving with less fatigue. However, too much exercise in a given day may leave you too tired.

(6) *Sleep.* Night driving is more tiring and stressful than day driving. Therefore, it is important to get enough rest and deep sleep before driving.



Eyeball Movement Using NVGs





NIGHT VISION GOGGLE DRIVING OPERATION

Night Vision Scanning Techniques



Scanning techniques. Night vision scanning techniques are important in object identification at night. Scan from right to left, or left to right, using a slow, regular scanning movement.

Identification by shape. Because your visual acuity is greatly reduced at night, objects must be identified by their shape or outline. Being familiar with the architectural design of structures common to your area will help



NIGHT VISION GOGGLE DRIVING OPERATIONS

Depth Perception



**The quality of seeing objects
as
three-dimensional solids in
space.**



NIGHT VISION GOGGLE DRIVING OPERATIONS

*Distance Estimation/Depth
Perception*





NIGHT VISION GOGGLE DRIVING OPERATIONS

Distance Estimation/Depth Perception



Clues used to aid in distance estimation and depth perception.

(Image A) *Linear perspective*. Parallel lines, such as railroad tracks, tend to converge as distance increases from the observer.

(Image B) *Apparent foreshortening*. The apparent shape of an object or terrain feature appears oval when viewed from a distance.

(Image C) *Vertical position on the field*. Objects or terrain features at a distance from the observer



NIGHT VISION GOGGLE DRIVING

OPERATIONS



Distance Estimation/Depth

(1) *Vertical position on the field*. Objects or terrain features at a distance from the observer appear higher on the horizon than objects or terrain features that are closer to the observer.

(2) *Motion parallax*. This clue to depth perception is often considered the most important. It refers to the apparent motion of still objects as seen by an observer moving across the landscape. For example, mountains in the distance appear to be moving with the vehicle.



NIGHT VISION GOGGLE DRIVING

OPERATIONS



Distance Estimation/Depth

(3) ***Retinal image size.*** The size of an image focused on the retina is perceived by the brain to be a certain size. The nearer a known object is to the observer, the larger is its retinal size. If the image decreases, the object is moving away. Comparison of an object such as a motor pool with an object of known size, such as a 5-ton truck, will help to determine the object's relative size and distance from the observer.



NIGHT VISION GOGGLE DRIVING

OPERATIONS



Distance Estimation/Depth Visual Illusions Perception

(1) Autokinesis. When a person stares at a still light in the dark, the light will appear to move in about 8 to 10 seconds.

(2) Relative motion. A person sitting in a car waiting for a train to pass often experiences the illusion of relative motion. Even though the car is not moving, the person has the sensation that it is moving.

(3) Structural illusions. These are caused by heat waves, rain, snow, or other factors that obscure vision. For example, a straight line may appear



NIGHT VISION GOGGLE DRIVING OPERATIONS

Sources of Ambient Light



- **The Moon**
- **Background Lighting**
- **Artificial Lights**
- **Solar Lights**
- **Lasers**



NIGHT VISION GOGGLE DRIVING OPERATIONS

Sources of Ambient Light



- (1)Moon.*** The moon provides the greatest source of ambient light at night. Light from the moon is brightest when the moon is at its highest point in the sky.
- (2)Background lighting.*** Besides the moon, other natural light sources contribute to night brightness, such as the aurora (Northern lights in the Northern Hemisphere) and starlight.
- (3)Artificial lights.*** Lights from cities, cars, fires, and flares are sources of illumination.
- (4)Solar light.*** This light is usable for certain periods following sunset and before sunrise.
- (5)Lasers.*** Lasers can affect the performance of the naked eye or night vision devices.



NIGHT VISION GOGGLE DRIVING OPERATIONS *What are Night Vision Goggles?*



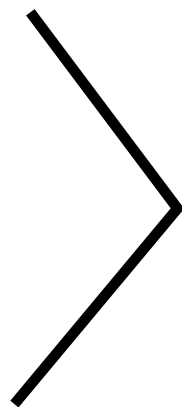
Night Vision Goggles are devices that make an object more visible during periods of low light level. Their performance is directly related to the amount of light available, such as starlight and moonlight.



NIGHT VISION GOGGLE DRIVING OPERATIONS *Advantages*



- Better view of the surrounding area and object identification at night
- NVGs make it possible
 - ✦ Read
 - ✦ Patrol
 - ✦ Provide medical aid
 - ✦ Drive
 - ✦ Walk
 - ✦ Observe the enemy





NIGHT VISION GOGGLE DRIVING OPERATIONS

Disadvantages



- ◎ **Performance is reduced in rain, haze, fog, snow or smoke.**
- ◎ **Visual acuity is reduced (details are not as clear).**
- ◎ **Limited field of view (peripheral vision limited).**
- ◎ **Reduced depth perception.**
- ◎ **Overconfidence.**
- ◎ **Focal range.**



NIGHT VISION GOGGLE DRIVING



OPERATIONS *Disadvantages*

NVG Performance is reduced in rain, haze, fog, snow, or smoke. Also, NVGs do not magnify images viewed through the tubes. An object viewed through the goggles at night will be the same size as if it were seen during the day without the goggles. Objects that are difficult to see during the day with the naked eye are also hard to detect at night with NVGs.

Visual acuity. A driver with 20/20 vision using NVGs will have, at best--

- 20/40 vision with the PVS-7, and
- 20/50 vision with the PVS-5.

NIGHT VISION GOGGLE DRIVING OPERATIONS

Disadvantages



Field of View. The field of view with the NVGs is 40 degrees compared to 200 degrees unaided.

Depth Perception and Distance Estimation.

- (1) NVGs provide their best depth perception between 20 and 500 feet.
- (2) NVGs decrease depth perception at distances less than 20 feet or greater than 500 feet.
- (3) Depth perception capability for NVGs will be less than daytime unaided but better than nighttime unaided.



NIGHT VISION GOGGLE DRIVING OPERATION *Disadvantages*



User Overconfidence. This seems to be the main problem associated with NVG use. After wearing the device for a short period, the user begins to feel he has complete visual acuity and depth perception when in fact he does not.

Focal range. The NVG will focus from 10 inches to infinity.



NIGHT VISION GOGGLE DRIVING OPERATIONS

Infrared Illuminator



**The IR (*INFRARED*) *ILLUMINATOR*
*provides artificial illumination***

- * It makes the NVG an active system
capable of being detected by
*THE THREAT.***



NIGHT VISION GOGGLE DRIVING OPERATIONS

General Characteristics



- **Single-Color Viewing**
- **Monochromatic Adaptation**
- **Dark Adaptation**
- **Spatial Disorientation**



NIGHT VISION GOGGLE DRIVING OPERATIONS

General Characteristics



Single-Color Viewing. All objects viewed through the NVGs will appear as a single color, green or yellow, depending upon the NVGs' construction. NVGs do not provide for color discrimination. As a result, it is difficult to distinguish between certain objects or features. Shadows, for example, are difficult to distinguish from puddles of water, walls from ditches and vice versa when viewed through the goggles at night.

It is critical that drivers take the lack of color discrimination into account when using NVGs.



NIGHT VISION GOGGLE DRIVING OPERATIONS

General Characteristics



Monochromatic (one-color) adaptation. Upon reentering a high ambient light environment after wearing the NVG for an extended time, you may experience a tint or discoloration of objects viewed with the unaided eye. This is a normal physical reaction that causes no discomfort and disappears after a short time.

Dark adaptation. Under ideal conditions (total dark adaptation before NVG use and removal of NVGs in a dark environment), you can expect to regain full dark adaptation in about 2 minutes.

Spatial disorientation. Dizziness and nausea may be



NIGHT VISION GOGGLE DRIVING OPERATION

General Characteristics



Second versus third generation tubes. There are two distinct generations (models) of NVG tubes with militarily significant performance differences: second and third.

- (1) All AN/PVS-5 NVG tubes are second generation. AN/PVS-7 tubes were produced in both second and third generation versions.
- (2) Third generation tubes have increased performance and longer tube life (about 7,500 hours). When they eventually fail, they tend to fail quickly.
- (3) Second generation tubes have a tube life projected at about 2,500 hours. They tend to fail slowly, so it is important that maintenance personnel check the devices periodically.

NIGHT VISION GOGGLE DRIVING OPERATION

General Characteristics



Battery. Always remove the battery before storing the goggles. When installing or removing a battery, make sure the selector switch is in the OFF position. If the rotary switch is in the ON position when installing the batteries, it causes an electrical surge, which can damage the tubes.

NIGHT VISION GOGGLE DRIVING OPERATION

General Characteristics

WARNING

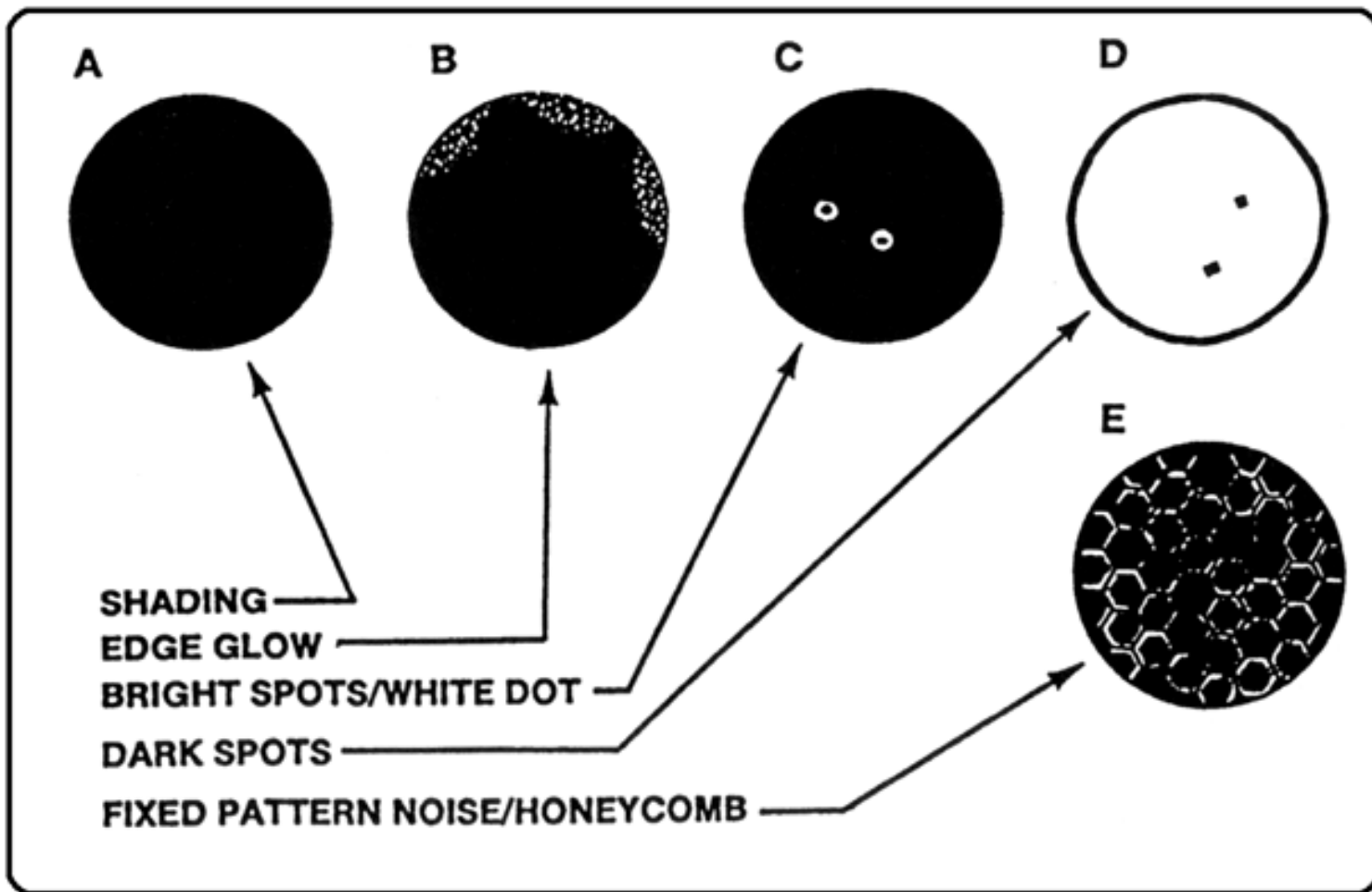
Batteries have safety vents to prevent explosion. When they are venting gas, you will smell it (very irritating) or hear the sound of gas escaping. Handle with care! Do not heat, puncture, disassemble, short circuit, recharge, or otherwise tamper with the batteries.





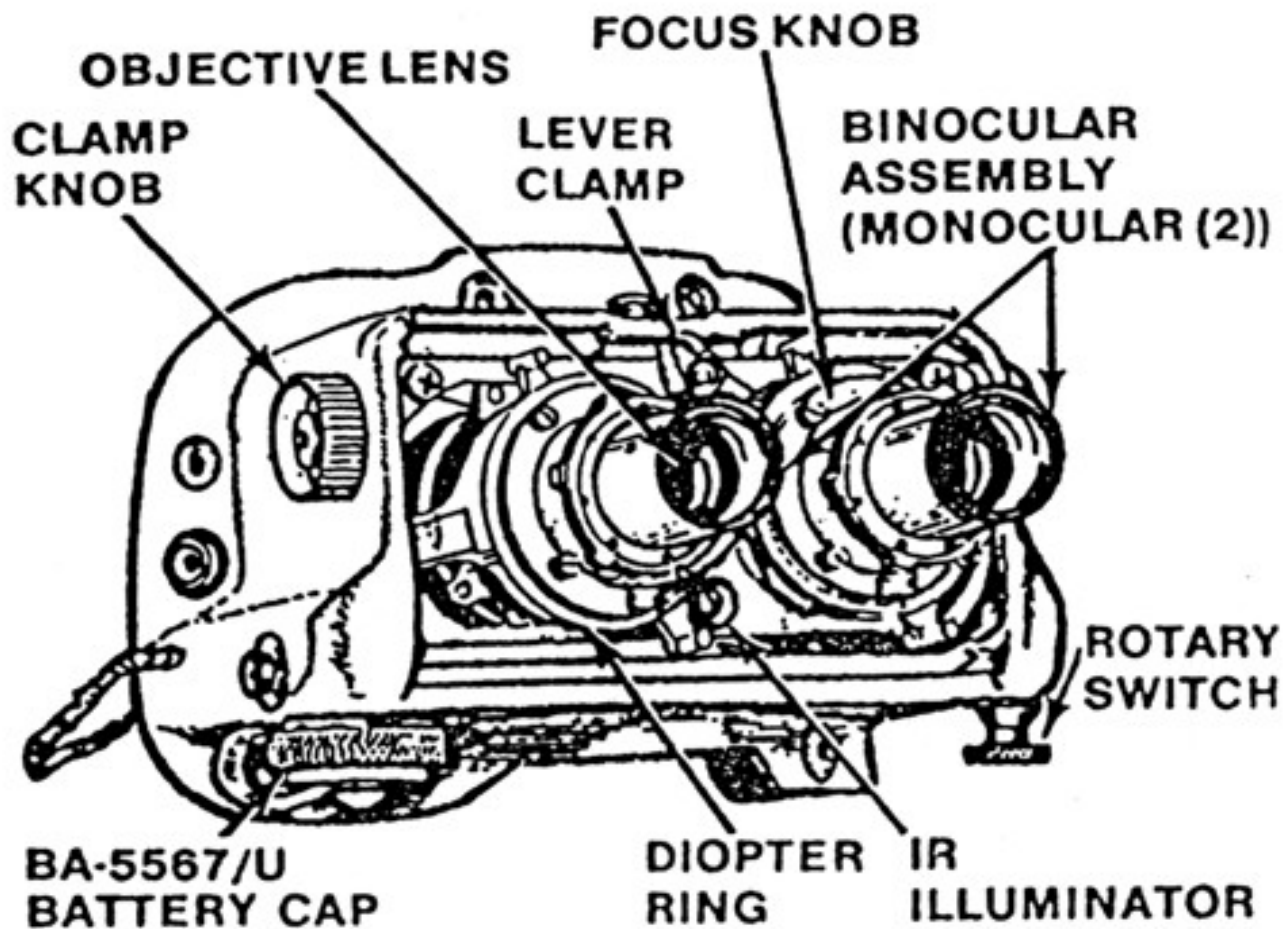
NIGHT VISION GOGGLE DRIVING OPERATIONS

Tube Defects



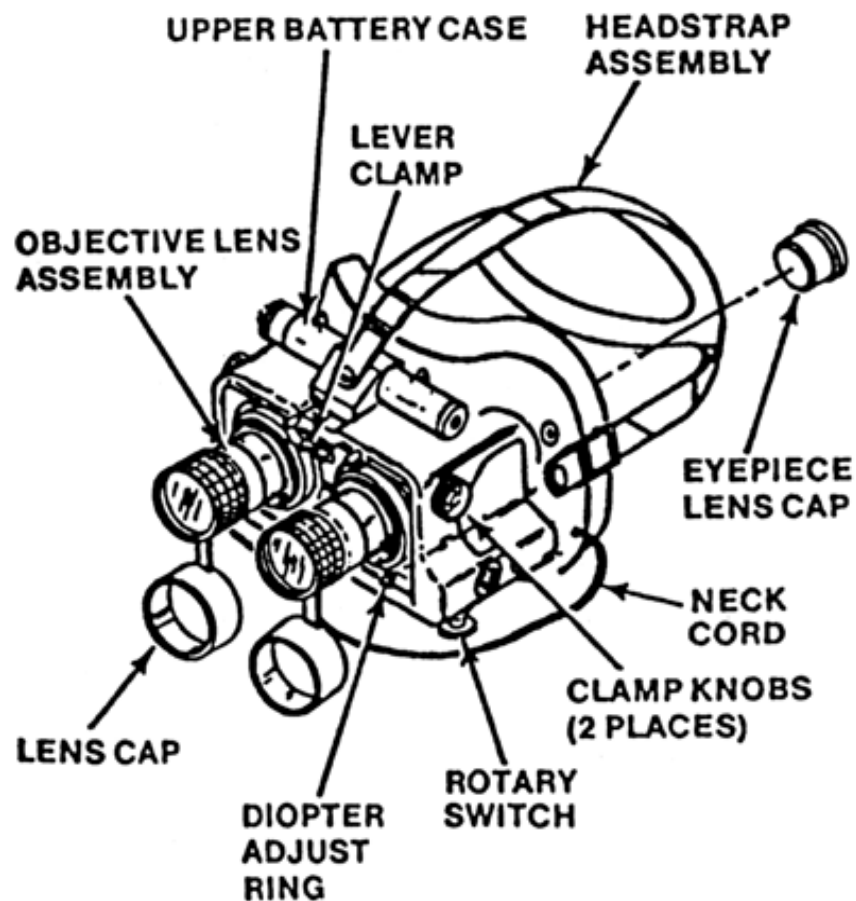
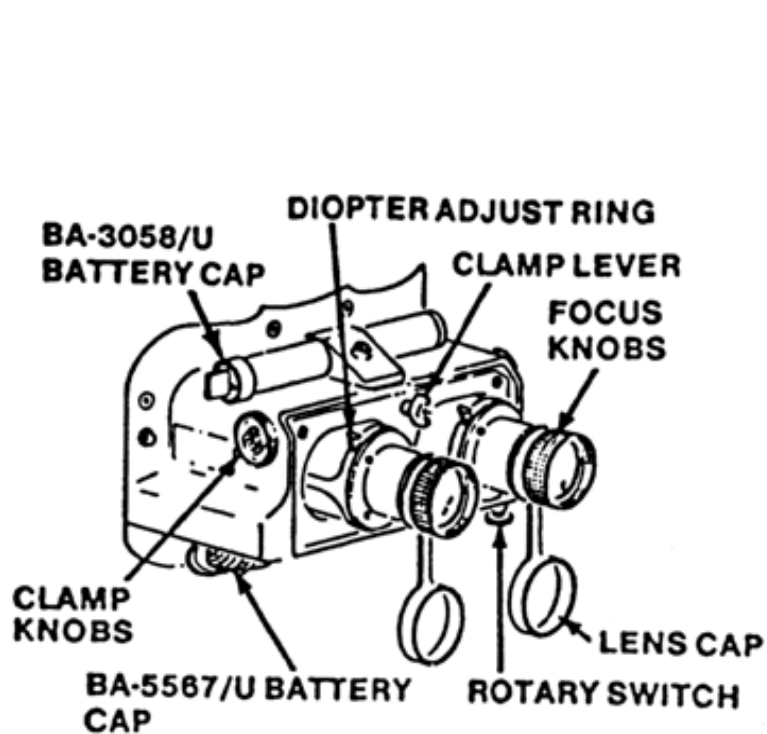


NIGHT VISION GOGGLE DRIVING OPERATIONS *AN/PVS-5 SERIES NVG*



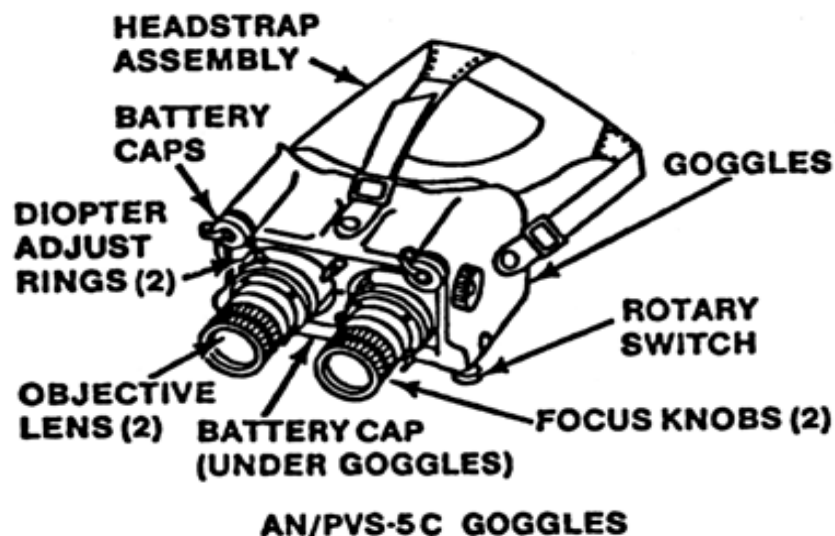
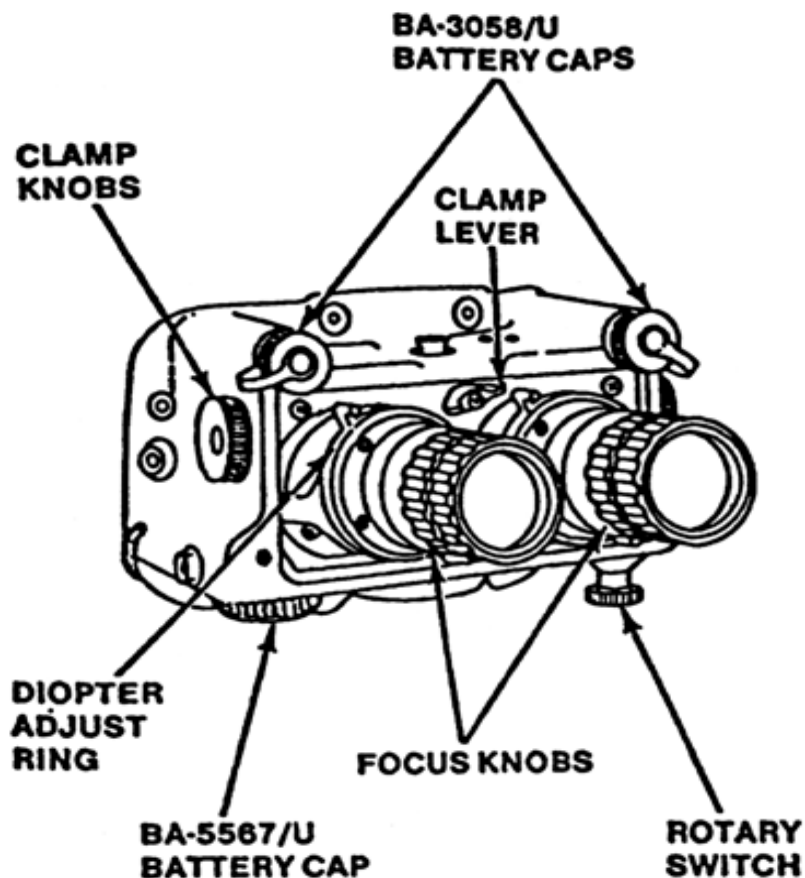


NIGHT VISION GOGGLE DRIVING OPERATIONS *AN/PVS-5 SERIES NVG*



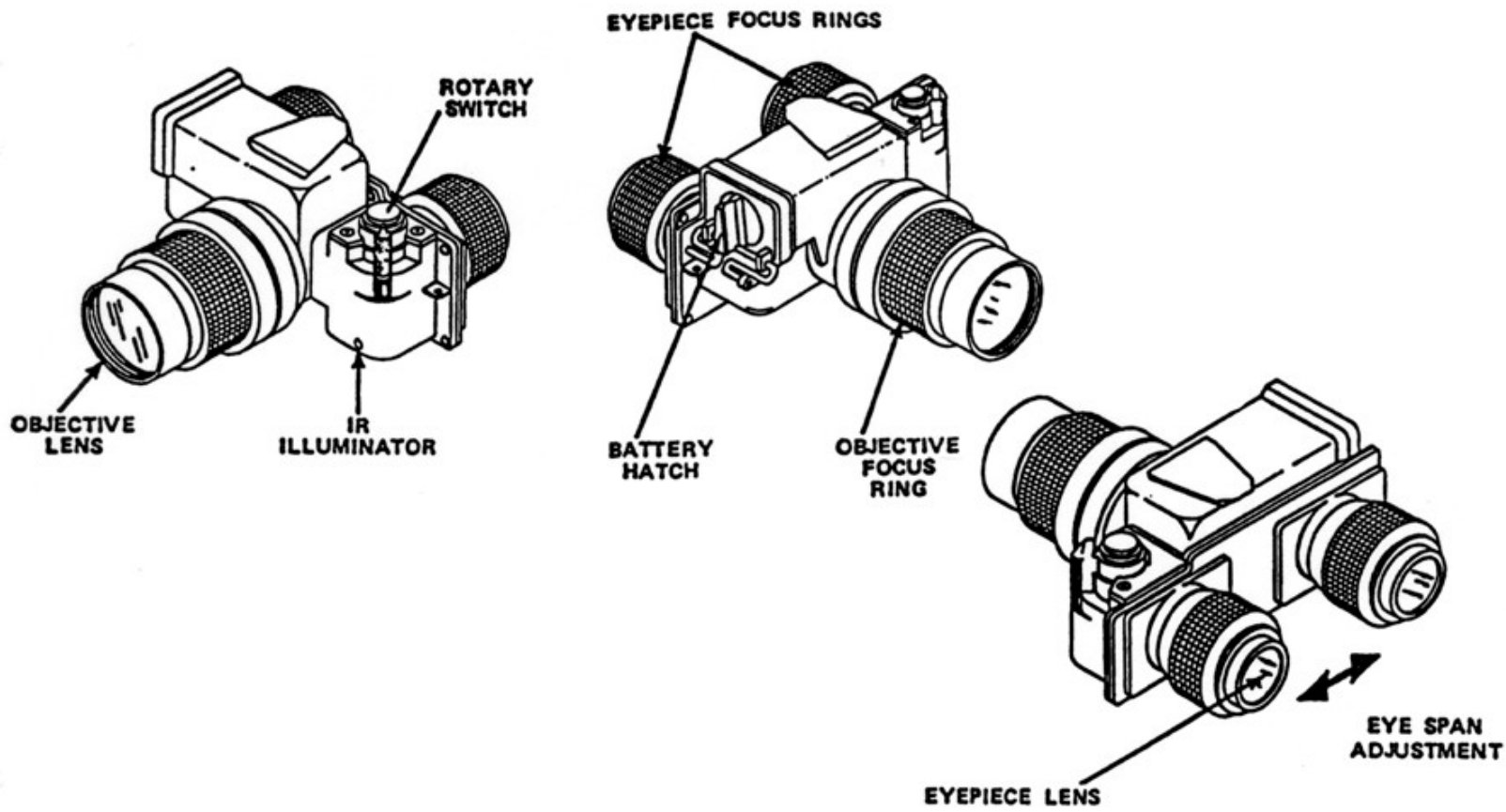


NIGHT VISION GOGGLE DRIVING OPERATIONS *AN/PVS-5 SERIES NVG*



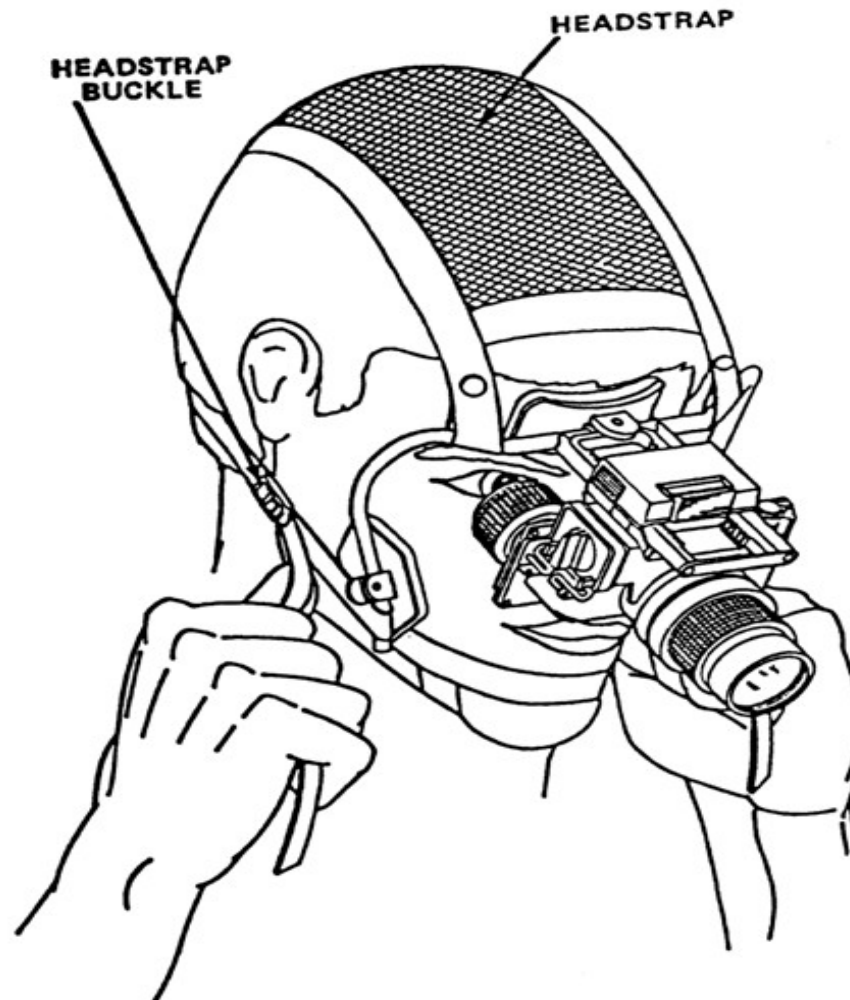


NIGHT VISION GOGGLE DRIVING OPERATIONS *AN/PVS-7A SERIES NVG*



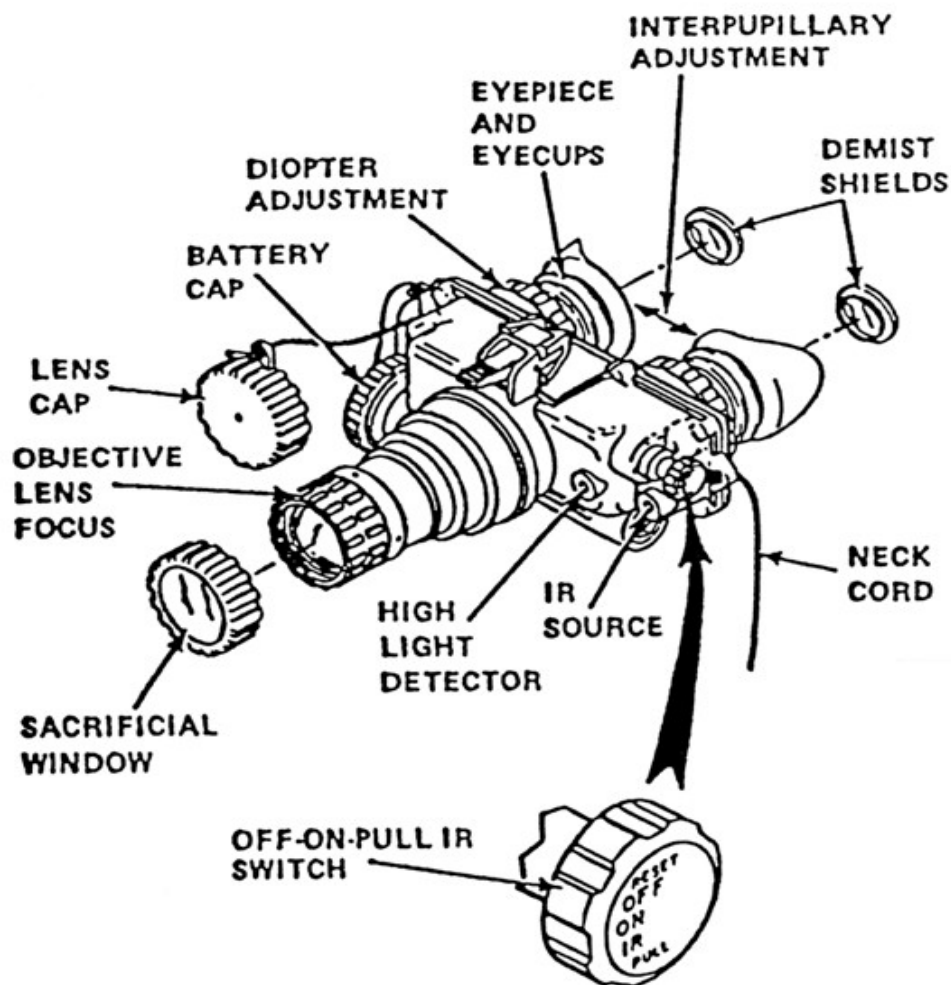


NIGHT VISION GOGGLE DRIVING OPERATIONS *AN/PVS-7A SERIES NVG*



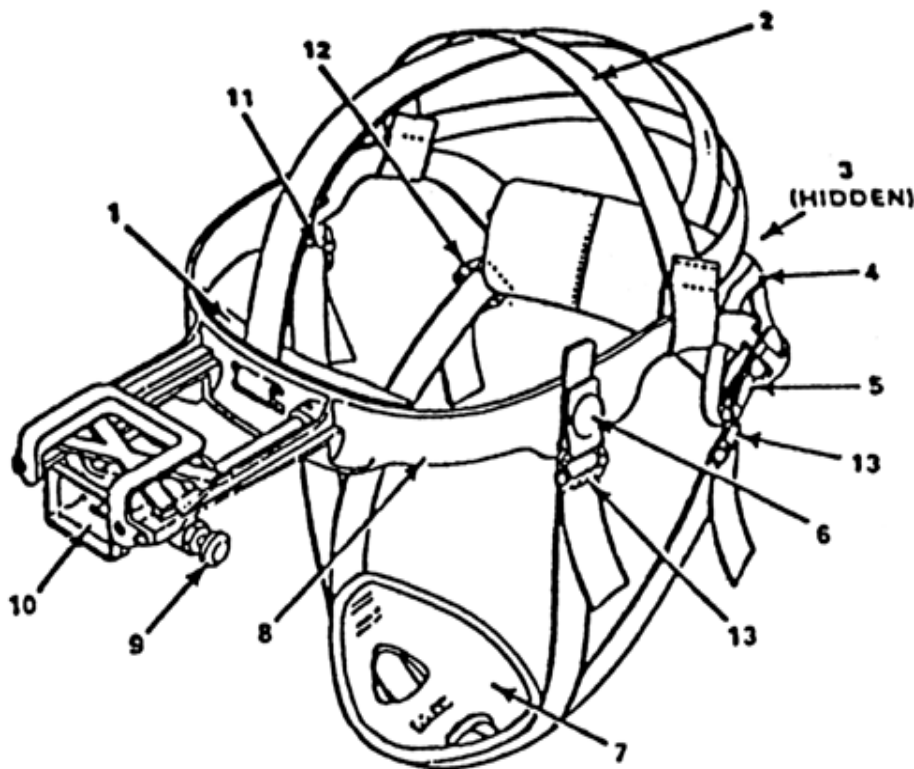


NIGHT VISION GOGGLE DRIVING OPERATIONS *AN/PVS-7B SERIES NVG*





NIGHT VISION GOGGLE DRIVING OPERATIONS *AN/PVS-7B SERIES NVG*



1. BROWPAD (THICK, MEDIUM OR THIN)
2. CROSS-STRAP ASSEMBLY
3. VERTICAL ADJUSTMENT
4. NECKPAD
5. LEFT REAR CHIN STRAP SNAP AND ADJUSTMENT
6. LEFT FRONT CHIN STRAP SNAP AND ADJUSTMENT
7. CHIN CUP ASSEMBLY
8. HEADBAND ASSEMBLY
9. SOCKET RELEASE BUTTON
10. HEADMOUNT SOCKET ASSEMBLY
11. RIGHT FRONT CHIN STRAP ADJUSTMENT
12. RIGHT REAR CHIN STRAP ADJUSTMENT
13. SLIDING BAR BUCKLES



NIGHT VISION GOGGLE DRIVING OPERATIONS

Effects of Light



**The following light sources can degrade
NVG performance**

- **Vehicle Lighting**
- **Instrument Lighting**
- **Lasers**
- **Artificial Lights**
- **Ambient Light Level**



NIGHT VISION GOGGLE DRIVING OPERATIONS

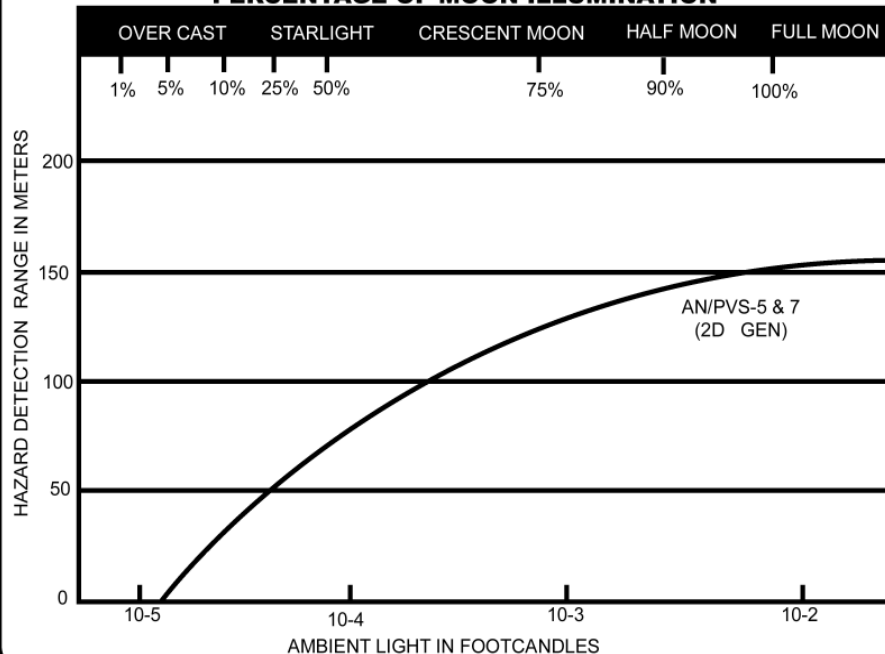
Hazard Range Limitation Graph

Ground Speed limitations

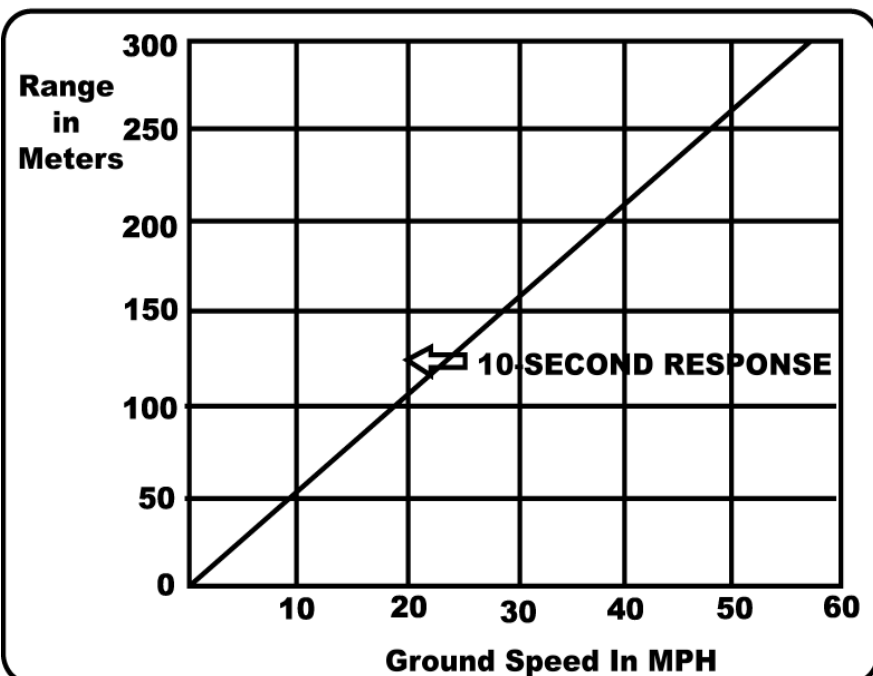


Hazard Range Limitation Graph

PERCENTAGE OF MOON ILLUMINATION



Ground Speed Limitations





NIGHT VISION GOGGLE DRIVING OPERATIONS

Driver Preparation



- **Keep physically fit.**
- **Eat a well-balanced meal.**
- **Get adequate rest.**
- **Avoid self-medication.**
- **Avoid the use of tobacco and alcohol.**
- **Avoid bright lights after dark adaptation.**
- **Avoid bright sunlight during the day.**



NIGHT VISION GOGGLE DRIVING OPERATIONS

Driving with Goggles



- Developed through continuous practice.
- Awareness of NVG *CAPABILITIES* and *LIMITATIONS* is *KEY*
- EMERGENCY PROCEDURES TO PRACTICE:
 - Effects of oncoming headlights
 - Tube failure while driving
 - Vehicle breakdown procedures
 - Low battery light indicator
- Speed Discipline
- Communication
- Assistant Operator Responsibilities



NIGHT VISION GOGGLE DRIVING OPERATIONS

Driving With The NVG



Phase I:

Drive a vehicle on a designated route in *DAYLIGHT* conditions.

Phase II:

Drive a vehicle on a designated route at night with vehicle headlights on (without NVGs).

Phase III:

- **Perform pre-operational NVG procedures.**
- **Perform vehicle PMCS (before OPERATIONS) while wearing NVGs.**
- **Drive a designated route at night with NVGs.**
- **Identify signs, route markings, ditches, etc.**
- **Perform post-operational NVG procedures.**
- **Perform vehicle PMCS (after OPERATIONS) while wearing NVGs.**

SAFETY FIRST !!!

NIGHT VISION GOGGLE DRIVING OPERATIONS



QUESTIONS ?